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# THE TONGUES OF WOODPECKERS

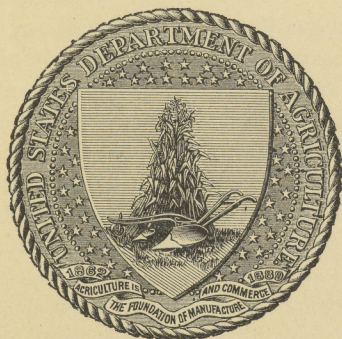
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# THE TONGUES OF WOODPECKERS.<sup>1</sup>

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RELATION OF THE FORM OF THE TONGUE TO THE CHARACTER OF  
THE FOOD.

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Whether the tongues of birds are of value in classification, or whether the modifications of the tongue, at least the external modifications, are due to adaptation to the character of the food or the manner in which food is manipulated, is a question of much interest. Unfortunately the food and feeding habits of birds are so little known that in many cases the adaptive characters of the tongue are not recognized, since without a knowledge of the one it is difficult or impossible to explain the peculiarities of the other.

The results of the preliminary investigation of the food of North American woodpeckers, made by the Division of Ornithology and Mammalogy of the Department of Agriculture, suggested that this group would be a most excellent one to study, and the tongues of all available species have been examined.

The woodpeckers are structurally a well-marked, compact group, and any variation in the structure of a given part, if shown to be directly correlated with some peculiarity of habit, would be a good indication that the one was dependent on the other. A comparison of the structure and modifications of the tongue with the results obtained from the examination of a large series of stomachs will, it is thought, show that just such a correlation does exist between the two, and that the form of the tongue varies surprisingly according to the nature of the food.

It is of course always necessary to bear in mind that the food of a bird necessarily varies with the season—a fact well shown by the group under consideration—and consequently that the peculiarity of the tongue may be related to some special kind of food, or particular method of obtaining it, pursued during a portion of the year only. A

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particular kind of food which could be best obtained by some special adaptive feature would naturally have more influence as a modifying agent, even if indulged in for only a short time, than a general diet for a long period, since the one would be positive in its effects, the other negative.

As the hyoid bone is the framework on which the tongue is built, it will be well to note some of its characteristic features in the woodpeckers before proceeding to the modifications of the tongue itself. The hyoid is so constructed as to combine the two characters of length and strength that are needed for extensile purposes. The front of the hyoid is formed by the short, fused cerato-hyals, although a groove, or in some cases a perforation, indicates the double origin of this bone. The basi-hyal is usually very long and very slender and the cerato-branchials abut upon its posterior end, the basi-branchial being absent, nor have any indications of this bone been found even in very young specimens. The cerato-branchials and epi-branchials are variable, especially the latter, which, as in the Sapsucker (*Sphyrapicus*), may be no longer than in many Passeres, or, as in the Flickers (*Colaptes*), reach the maximum length among birds. The epi-branchials curve up over the back of the skull, meet on its summit, and continue on toward the forehead. In other long-tongued birds, as in the humming bird (*Trochilus*), for example, the apposed bones reach to the base of the bill, but in the longest-tongued woodpeckers they turn to the right, pass through the right narial opening, dipping under the nostril, and thence continue quite to the tip of the bill, so that in these species the extreme possible length of tongue is reached unless some other device is resorted to.<sup>1</sup> The cerato-branchials lie side by side when the tongue is protruded, and even when it is withdrawn they are posteriorly but little separated. The general character of the hyoid is constant in all species examined, but, as just stated, the proportions of its component parts vary, the extremes being represented by the Sapsucker (*Sphyrapicus*) and Flicker (*Colaptes*), both of which are figured (Pl. III, figs. 1, 3).

Externally the tongue consists at the tip of a horny portion more or less barbed along the edges; this is followed by a section covered with tough skin bearing on the upper surface a long patch of minute points, while the basal portion is clothed with smooth, elastic skin, which is more or less wrinkled transversely when the tongue is retracted. The skin covering the base of the tongue is reflected, forming a sort of sheath, into which the basal part of the tongue is withdrawn when at rest. The shape of the patch of minute points, as well as the number and character of the points themselves, seems to vary in different species,

<sup>1</sup>It would appear that a method is already in use by which the length of the tongue can be greatly increased, and this is the curling of the free ends of the epi-branchials into a spiral. Although I have never met with a specimen in which the hyoid was so arranged, both Dr. Bryant and Mr. Wm. Palmer have recorded specimens in which the hyoid encircled the eye. Dr. Bryant's paper, entitled "Remarks on *Sphyrapicus varius*, Linn.," appeared in Proc. Bost. Soc. Nat. Hist., Vol. X, 1864-'66, pp. 91-93.

and, although these points are so small as to appear like mere granulations, they are seen under the microscope to have a perfectly definite form and to be directed backward (Pl. III, figs 8, 9.) They are smallest toward the front of the patch, and increase in size from thence backward.

The anterior, horny portion of the tongue is also subject to great variation. In most species it is armed on either side with a number of sharp, backwardly-directed spines, but these may vary in number from two or three in the Flicker (*Colaptes*, Pl. II, fig. 10), up to thirty or forty in the Redhead (*Melanerpes*, Pl. II, fig. 2). One specimen of Flicker, labeled *Colaptes hybridus*, Pl. I, fig. 1), had the tip of the tongue wholly unarmed; but this may have been an individual peculiarity, and if so, would be interesting as showing the retention in the adult of the condition found in the young. In the Sapsucker (*Sphyrapicus*) the tongue bears no spines, but two series of stiff hairs, the lower set directed outward, the upper series backward. Of course, strictly speaking, these hairs are simply very slender spines, and in the California Woodpecker (*Melanerpes formicivorus bairdi*, Pl. II, fig. 1) we find an almost intermediate stage, the spines being quite fine, and the sides of the tongue, as in a few other species, furnished with a few short hairs lying below the spines and directed outward and forward.

In very young woodpeckers the tongue is unarmed at the point, bearing neither hairs nor spines, although the patch of minute points on the upper surface is present from the first. Later on, as indicated by a fully-fledged nestling of the Downy Woodpecker (*Dryobates pubescens*, Pl. III, fig. 6), a species whose tongue, when adult, is armed with sharp barbs, the spines are represented by short, fine, reflexed hairs, like the upper series of the Sapsucker (*Sphyrapicus varius*). Thus it would seem that the lateral spines are acquired after the bird has commenced to fly, and that they must be developed very rapidly, although specimens showing the various stages in their acquisition are lacking. The growth of the hyoid must be correspondingly rapid, for in the nestling alluded to the ends of the epi-branchials reached only to the center of the skull, although the Downy is a long-tongued bird whose hyoid runs beneath the nostril into the bill. This rapid growth has been observed in the hyoid of humming birds, in which the growth of the bill is also very rapid after hatching, and it would appear that great changes take place in the tongue and beak about the time the young bird ceases to be fed and begins to feed itself.

If woodpeckers were to be classified by their tongues we would start with forms like Delattre's Woodpecker (*Ceophlæus scapularis*, Pl. II, fig. 11), and Flicker (*Colaptes auratus* or *C. chrysoides*, Pl. II, fig. 10), in which the tongue is armed with two or three points on each side; pass through the Pileated Woodpecker (*Ceophlæus pileatus*, Pl. II, fig. 9), into the White-headed Woodpecker (*Xenopicus albolarvatus*, Pl. II, fig. 8), and Downy Woodpecker (*Dryobates pubescens*, Pl. II, fig. 4),

and thence to such species as the Gila Woodpecker (*Melanerpes uropygialis*, Pl. II, fig. 6). Thence through the Three-toed Woodpecker (*Picoides*, Pl. II, fig. 5) and the Ladder-back Woodpecker (*Dryobates scalaris*, Pl. II, fig. 3), we reach the Redhead Woodpecker (*Melanerpes erythrocephalus*, Pl. II, fig. 2) and California Woodpecker (*Melanerpes formicivorus bairdi*, Pl. II, fig. 1), while between these and the short, brush-tongued Sapsucker (*Sphyrapicus*, Pl. I, fig. 12), there is a gap to be bridged over.

Considering the tongues in relation to food, we find that those of the various species of Flickers (*Colaptes*, Pl. I, fig. 3) have the fewest terminal barbs and the longest dorsal tract of fine points; they are also among the longest. The members of the genus are particularly fond of ants, and the tongue seems especially adapted for probing ant hills. The function of the fine points on the upper part of the tongue seems to be to form a rough surface to which the sticky saliva will readily adhere and to which in turn the ants will be stuck. In this genus the submaxillary salivary glands reach the maximum size in the group.

The Hairy and Downy Woodpeckers (*Dryobates villosus* and *D. pubescens*, Pl. I, fig. 4), and also the Pileated Woodpecker (*Ceophlæus pileatus*) feed more or less on the larvæ of beetles (*Coleoptera*), and these have sharply barbed tongues, well adapted for spearing grubs or for coaxing them out of their hiding places. Hence it seems extremely probable that other species similarly provided have similar food habits. In these species, and in others with sharply barbed tongues, the dorsal tracts of points vary in shape and extent as well as in the size and number of the points, but in none are they as long as in the Flicker (*Colaptes*). The same is true of the submaxillary glands, which are all smaller than in the Flicker.

The Red-headed Woodpecker (*Melanerpes erythrocephalus*, Pl. I, fig. 9), although having a peculiar tongue, has one which is less evidently specialized than those of other species, and one which suggests the fringed tongues of some finches and other passerine birds. In diet this bird appears to be the most omnivorous of the species examined, eating a large proportion of fruit, or vegetable food, the total amount for some months equaling that of the insect food. The species is evidently fond of grasshoppers, but whether or not there is any direct relation between the character of its tongue and that of its food is not evident.

The Sapsucker (*Sphyrapicus varius*, Pl. I, fig. 12) drills into the maples, birches, mountain ash, and apple trees, and feeds upon the sap as well as upon the insects which are attracted by it. The tongue may be used in two ways: either the fringe of stiff hairs may serve as a brush, to which a considerable quantity of sap would adhere, or it may serve by capillary attraction to guide the sap from the little pits in which it gathers to the front part of the tongue.

The tongue of the Sapsucker is much less extensile than that of any other woodpecker examined, and this lack of extensibility is a charac-

teristic of the tongues of insectivorous birds, such as the swifts and swallows. The spines of the upper surface of the tongue also reach their greatest size in the Sapsucker (*Sphyrapicus*), and spine-clad tongues are another characteristic of insect-eating birds. The insectivorous diet of the Sapsucker is further indicated by the fineness of the backwardly directed spiny processes at the base of the tongue and about the opening of the trachea, their use being apparently to facilitate the passage of food past the larynx.

The direct relation of the modifications of the tongue to the character of the food can perhaps be best appreciated by comparing the figures of the tongue, and particularly the enlarged figures of the tongue tips, with the table giving the summary of the food. It will be seen, too, by further comparison that there is a direct relation between the form of the bill, the tongue, and the number of larvæ eaten. Those species which have bills best adapted for cutting into trees containing larvæ, and tongues most capable of extracting them from their hiding places, eat the most. Thus the Three-toed and Pileated Woodpeckers (*Picoides* and *Ceophlæus*) stand at the head of the list, closely followed by the members of the genus *Dryobates*. At the other extreme is the Sapsucker (*Sphyrapicus varius*), for this species was only once found to have eaten larvæ, and in this instance they were probably not obtained by cutting into wood. It should be noted, as showing the importance of the modifications of the tongue, that the Flicker (*Colaptes*), which has a curved bill, not well adapted to cut into trees after grubs, has, next to the Redhead (*Melanerpes*) and Sapsucker (*Sphyrapicus*), eaten the smallest percentage of larvæ of any species examined.

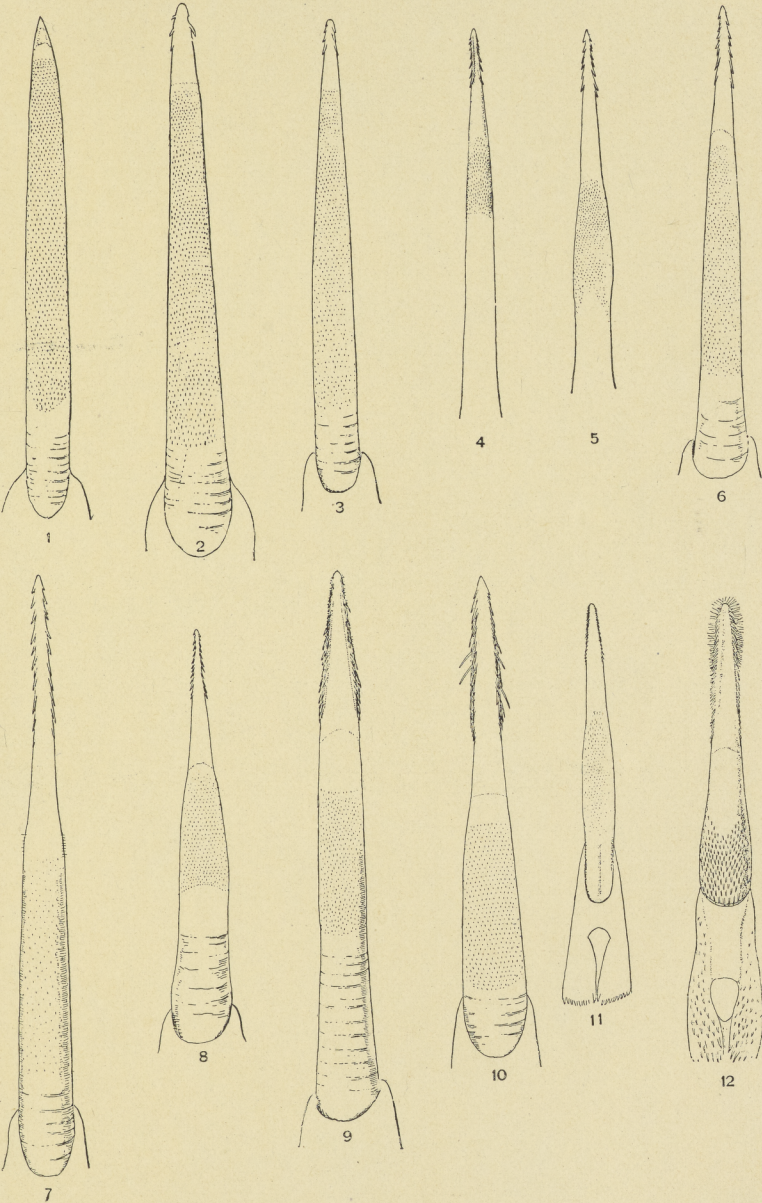
Altogether the evidence favors the view that modifications of the tongue are directly related to the character of the food and are not of value for classification.

PLATE I.

Tongues of North American Woodpeckers (all viewed from above and enlarged  $2\frac{1}{2}$  diameters).

Fig. 1. Hybrid Flicker (*Colaptes*). Fort Pierre, S. Dak.

2. Delattre's Woodpecker (*Ceophlæus scapularis*). Tabasco, Mexico.
3. Gilded Flicker (*Colaptes chrysoides*). San Jose del Cabo, Lower California.
4. Downy Woodpecker (*Dryobates pubescens*). Washington, D. C.
5. White-headed Woodpecker (*Xenopicus albolarvatus*). Clarks Fork, Columbia River, Washington.
6. Hairy Woodpecker (*Dryobates villosus*).
7. Gila Woodpecker (*Melanerpes uropygialis*). Fort Huachuca, Ariz.
8. Three-toed Woodpecker (*Picoides arcticus*). Illinois.
9. Red-headed Woodpecker (*Melanerpes erythrocephalus*). Northern Illinois.
10. California Woodpecker (*Melanerpes formicivorus bairdi*). Stockton, Cal.
11. Ladder-back Woodpecker (*Dryobates scalaris*). Matamoras, Mexico.
12. Red-naped Sapsucker (*Sphyrapicus varius nuchalis*). Fort Wingate, N. Mex.



TONGUES OF WOODPECKERS.

PLATE II.

Tips of tongues of North American Woodpeckers (all save 4 viewed from above and enlarged  $9\frac{1}{2}$  diameters).

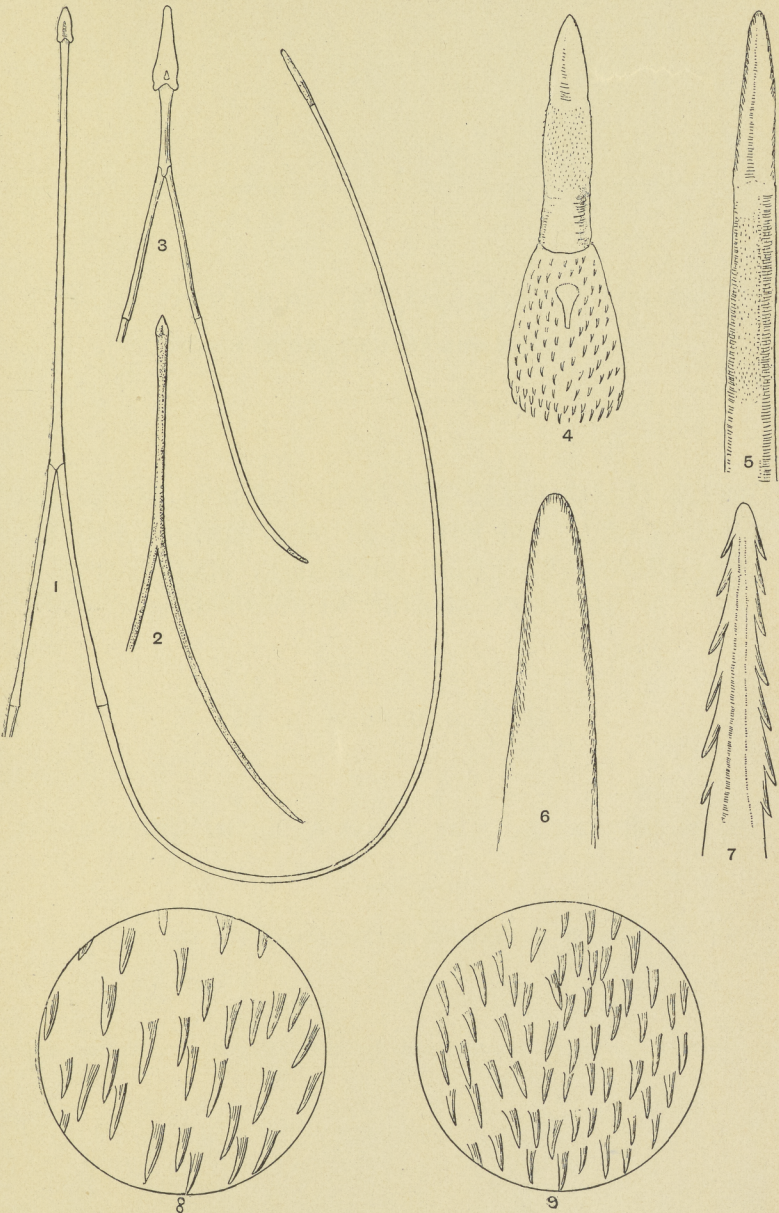
- Fig. 1. California Woodpecker (*Melanerpes formicivorus bairdi*). Stockton, Cal.  
2. Red-headed Woodpecker (*Melanerpes erythrocephalus*). Northern Illinois.  
3. Ladder-back Woodpecker (*Dryobates scalaris*). Matamoras, Mexico.  
4. Downy Woodpecker (*Dryobates pubescens*). Washington, D. C.  
5. Three-toed Woodpecker (*Picoides arcticus*). Illinois.  
6. Gila Woodpecker (*Melanerpes uropygialis*). Fort Huachuca, Ariz.  
6a. Another specimen showing variation due to wear of tongue. San Jose del Cabo, Lower California.  
7. Hairy Woodpecker (*Dryobates villosus*).  
8. White-headed Woodpecker (*Xenopicus albolarvatus*). Clarks Fork, Columbia River, Washington.  
9. Pileated Woodpecker (*Ceophlæus pileatus*). Louisiana.  
10. Gilded Flicker (*Colaptes chrysoides*). San Jose del Cabo, Lower California.  
11. Delattre's Woodpecker (*Ceophlæus scapularis*). Tabasco, Mexico.



TONGUES OF WOODPECKERS.

PLATE III.

- Fig. 1. Hyoid of Flicker (*Colaptes auratus*) (adult,  $\times 2$ ).  
2. Hyoid of Flicker (*Colaptes auratus*) (recently hatched,  $\times 2$ ).  
3. Hyoid of Red-naped Sapsucker (*Sphyrapicus varius nuchalis*) ( $\times 2$ ).  
4. Tongue of recently hatched Downy Woodpecker (*Dryobates pubescens*) ( $\times 4$ ).  
5. Tongue of fully-fledged nestling of Downy Woodpecker (*Dryobates pubescens*) ( $\times 3\frac{1}{2}$ ).  
6. Tip of tongue of fully-fledged nestling of Downy Woodpecker (*Dryobates pubescens*) ( $\times 6$ ).  
7. Tip of tongue of adult Downy Woodpecker (*Dryobates pubescens*) ( $\times 6\frac{1}{2}$ ).  
8. Spines from dorsal tract of tongue of Red-headed Woodpecker (*Melanerpes erythrocephalus*) (greatly enlarged).  
9. Spines from dorsal tract of tongue of Ladder-back Woodpecker (*Dryobates scalaris*) (greatly enlarged).



TONGUES OF WOODPECKERS.